A HEMOPHILIC, ANAEROGENIC PARACOLON BACILLUS FOUND IN A CASE OF INFECTED BILATERAL HYDRONEPHROSIS

K. F. MEYER AND F. HINMAN

From the George Williams Hooper Foundation for Medical Research and the Department of Urology, University of California Medical School, San Francisco

In the course of a systematic investigation of urinary infections primarily undertaken with the aim to reclassify by modern methods the various causative types and the subdivisions of the colon-paracolon group, we found an organism which was only cultivated on hemoglobin medium. This bacillus reverted atavistically to a saprophytic nongas-producing paracolon after artificial cultivation. A similar transformation of type took place in the urine of the host following vaccination and clinical recrudescence. The organism is here described and an account given of the case from which it was obtained.

HISTORY OF THE CASE

A woman, aged 35, had always enjoyed excellent health up to a short time following her last childbirth. May, 1915. There was no history of focal infection such as teeth abscesses or tonsillitis. Following childbirth she had intermittent attacks of chills and fever which were attributed to an infection in the broad ligament of the left side. The urine was negative on examination and cultural study was not made. Later in May examinations of the urine showed a bacilluria due to a peculiar type of gram-negative (colon bacillus?) bacillus with a few polynuclear cells and a few hyaline casts. A blood culture was negative; spleen large and soft; marked hemorrhoids, not infected. The general poor condition continued; the hemorrhoids were troublesome and she complained of pain in the neck, principally in the back, and asthenia. In August, 1917, the urine still showed a slight trace of albumin with a number of white cells and bacteria. The patient was treated by rest in bed, regulation of diet, and control of the bowels in an attempt to relieve the urinary infection. In the latter part of 1917, the hemorrhoids were removed by operation. Complete gastro-intestinal studies made about this time were negative with respect to gallbladder or intestinal focus.

In June when the patient first came under our observation, the total phthalein output was 65% and bacteriologic study of the urine showed a gram-negative bacillus which grows only on blood agar plates. A stool specimen examined in June showed normal flora. Plain roentgenograms of kidneys, ureters and bladder were negative. A more complete urologic study later in June showed a condition of bilateral hydronephrosis with a tortuous ureter and movable kidney on the right side. On the left the hydronephrosis was apparently due to a valvelike obstruction at the ureteropelvic juncture. Infrequent attacks of fever with dull

Received for publication March 16, 1920.

pain in the right or left side and severe headaches lasting for several days continued to recur. The patient was vaccinated during the months of July, August and beginning of September with a heat-killed suspension of the hemophilic organism and B. alkaligenes.

In Sept., 1918, ureteropyelography confirmed the previous finding and showed a rather dilated and tortuous upper right ureter and a hydronephrosis with a pelvic capacity of 40 c c and marked blunting of the minor calyces. The pyelogram of the left kidney was definitely square-shaped but its ureter was not dilated. The left pelvis had a capacity of approximately 45 c c. The separate phthalein output showed marked variation according to whether the tip of the ureteral catheter had entered the respective pelvis or not, as for example, on March 11, 1919, phthalein with the right catheter not in the right pelvis, but the left one well up in the pelvis appeared on the left side in 5 minutes, right side 8 minutes; the first 15 minute output, right side 2%, left side 15%, whereas, on March 14, with the position of the catheters reversed, the phthalein output on the right was 10% and on the left 5%. Total phthalein on March 13, 1919, was 30% first hour—second hour not taken. On April 10, total output was 27% first hour, and 11% second hour. Repeated phthalein estimations have shown a very definite and progressive diminution in renal function during the last 2 or 3 years.

The bacteriologic results with catheterized urine specimens obtained by us from June, 1918, to April, 1919, follow:

June 6, 1918: Bladder Urine: hemophilic organism, streptococci.

June 8, 1918: Bladder: hemophilic bacillus and B. alkaligenes. Right Kidney Urine: sterile, direct and enriched. Left Kidney Urine: hemophilic bacillus; enriched in plain broth sterile.

June 10, 1918: Bladder Urine: hemophilic bacillus and B. alkaligenes.

June 14, 1918: Bladder: hemophilic bacillus. Right Kidney: sterile direct; enriched in blood broth; hemophilic organism. Left Kidney: hemophilic bacillus.

June 18, 1918: Bladder: hemophilic bacillus. Right Kidney: sterile direct, enriched few cocci. Left Kidney: hemophilic bacillus and B. alkaligenes.

Sept. 15, 1918: Bladder direct: ∞ anaerogenic paracolon growing on non-hemoglobin mediums and B. alkaligenes in one drop of urine. Right Side: B. alkaligenes. Left Side: sterile, direct and enriched.

Sept. 19, 1918: Bladder: ∞ paracolon few B. alkaligenes. Right Side: few paracolon and innumerous B. alkaligenes.

March 11, 1919: Bladder: ∞ paracolon. Right Side: sterile. Left Side: ∞ paracolon.

April 26, 1919, a plastic operation on the left renal pelvis was made under gas and oxygen—Heineke-Mikulicz incision being made at the ureteropelvic juncture to enlarge the pelvic outlet. Culture of the urines obtained May 16 showed an entirely different type of infecting organism, namely, a pure colon bacillus, the typical organism previously found having entirely disappeared. The patient has been under observation since the operation to the present time and there has been no reappearance of the previous type of infection.

BACTERIOLOGIC FINDINGS. THE HEMOPHILIC ANAEROGENIC PARACOLON BACILLUS

The first specimen of catheterized urine collected in June, 1918, was plated in routine fashion on endo and sheep blood-veal agar plates; 4 c c of clear urine were also enriched in plain glucose broth. After 24 hours' incubation only 3-4 small, slightly reddish streptococcus colonies were observed on the endo-plates; the blood medium, however, was covered with innumerable discrete whitish

colonies not unlike those of B. influenzae. On closer inspection the isolated colonies were somewhat raised and very viscid on touch with a platinum needle. Microscopically, the growth consisted of short, stumpy or coccoid gram-negative bacilli. The enriched broth tubes were clear and showed only a faint, filmy sediment. Veal, peptic digest, casein and veal-ascitic fluid—or beef serum-agar plates with and without blood gave an identical result, namely, small colonies appeared only on the blood plates. Even after incubation for from 5-10 days no growth was visible. The phenomenon repeated itself, in the course of frequent cultures made from the urine of the bladder and ureters; as a rule the B. alkaligenes grew on all the mediums employed yet the predominant bacillus was only cultivated on a hemoglobin containing substrate.

Specimens of urine obtained on Sept. 15, 16, 19 and thereafter until March 11, 1919, gave, however, a very fine dewdrop-like growth of the originally strictly hemophilic organisms on ordinary plain or glucose or serum agar after 48-72 hours' incubation. On blood plates the growth was more profuse, the colonies were larger and somewhat darker in color. In the meantime, the strictly hemophilic strains having been kept on blood agar and tested at weekly intervals on plain agar, had acquired the property to grow fairly easily on blood-free mediums. On the average 10-12 transplantations on blood mediums were necessary to convert the parasitic, hemophilic type into a saprophytic one, which as such permitted a definite classification.

For the sake of clearness it appears advisable to describe collectively the findings on the parasitic strains isolated from June, 1918, until March, 1919, and those of the saprophytic strains as they developed either in the fresh specimen since Sept., 1918, or in the test tubes as a result of frequent transplantations. In this connection it may be stated that only purified cultures were investigated and that on several occasions 50 colonies of the hemophilic organism were tested on plain agar slants. Detailed studies were, however, made only with 5 representative offsprings of the parasitic and of the saprophytic colonies, respectively. The composition and reaction of the mediums were always identical and the differences between the two types of the same organism can therefore only be explained on the basis of an adaptation phenomenon. The characteristics of the strains are:

1. *Parasitic Strains:* Morphology: The urinary sediment of the left ureter as a rule gave a pure culture of the organism under consideration. Smears showed small coccoid-like bacilli which in shape and size resembled B. melitensis or certain forms of B. pseudo-influenzae; they were always immotile. In stained preparations they appeared as gram-negative short rods (0.3-1.5 mikrons), usually arranged in clusters. Some forms may show indications of a capsule. Material from cultures emulsified poorly but stained readily; the single organisms were generally in the first generation surrounded by a halo, suggesting a zooglea-like capsule, which was easily demonstrated tinctorially by treating the fixed smear with weak acetic acid. Some forms stained bipolarly and resembled in size B. coli. No flagella could be made visible. In old liquid cultures long filaments and other pleomorphic forms were constantly noted. The single organisms always appeared separated by a mucoid-intercellular substance.

Cultural Characteristics.—On blood plates small gray-whitish colonies developed readily inside of 24-36 hours under aerobic or semi-anaerobic environment. The bacillus was mesophile, the optimum temperature for growth was 37 C. At 22-25 C. occasionally a poor and slow growth was noticed. Under 20 C. no growth took place. In the course of a few days the colonies appeared

rather raised, conical, slimy and moist; they were very viscid and of mucous consistence. Occasionally threads of from 2.5 cm. in length could be easily withdrawn by touching them with a needle. The medium was not altered in color; there was no hemolysis. On blood plates and particularly on cooked hemoglobin mediums, a film-like, diffuse growth with a slight brownish discoloration in the butt was readily obtained. The water of condensation showed a stringy, slimy sediment. In blood broth a whitish sticky film covered the layer of red cells; after 6-8 days' incubation the hemoglobin was discolored and perhaps a slight turbidity of the supernatant broth was visible. The later reaction, being in our opinion the result of acid-split products, was particularly noted in glucose-blood broth tubes. Repeated attempts to grow the bacillus on various other hemoglobin free mediums failed. In sterile urine or urine broth no growth was obtained. Successive transplantations on blood agar produced a profuse saprophytic growth, which after 10-12 series was successively transferred to plain and to glycerin agar. The viability even on blood plants was only slight and weekly transfers to fresh mediums were necessary to keep the organism alive. Heating from 53-54 C. for 30 minutes sufficed to kill the organism when heavily suspended in salt solution.

2. *Saprophytic Strains.*—Morphology: Tinctorially and otherwise the strains differed in no respect from the hemophilic ones. When first isolated they fully possessed a distinct capsule which was, however, lost by artificial cultivation on plain agar; it was retained for about 10-20 generations on glycerol agar or broth.

Cultural Characteristics.—On peptic digest or glycerol or glucose agar plates seeded with urine obtained after the patient had been vaccinated with a suspension of the hemophilic bacilli, very small, streptococcus-like colonies made their appearance as a rule after 36-48 hours' incubation. In the course of 5-10 days these colonies increased slightly, acquiring a more slimy and raised appearance. The margins were sharp or slightly irregular. On glycerol agar the colonies were somewhat larger, markedly convex and very slimy; when touched with a wire loop the entire colonies were usually removed. Even on slants there was no tendency for spreading. The water of condensation had a slimy sediment. Broth cultures (glucose and glycerol) inoculated with the second or third generation showed occasionally a faint turbidity after 24 hours' incubation, which gradually disappeared in the course of another 24 hours; the tubes showed a clear upper part with a tenacious, slimy sediment. By shaking, a tuftlike formation was obtained, which remained for some time in the glycerol tubes the whole medium being very viscid. There was no gas, but a slight acid production in glucose broth. On Loeffler's serum and ascitic fluid agar a fairly thick, more or less compact viscid deposit was formed. On potatoes the recently isolated saprophytic strains failed to grow; the older strains cultivated artificially for over one year and six months gave a faintly visible film. Milk was not coagulated, but slightly acidified after from 4-6 days' incubation. Gelatin plate or stab cultures show after from 10-12 days small punctiform colonies with a finely granular inside structure. This medium is never liquefied, strains grown on glycerol or plain agar become more and more saprophytic and the cultures on the hand to day grow quite freely, but in comparison with B. coli less abundantly. Two strains under observation exhibit in this respect growth characteristics which resemble those of a stock culture of B. dysenteriae Shiga. In liquid mediums and in brain suspensions the bacteria will remain viable for at least 2 to 3 weeks.

Some of the nonhemophilic strains produced indol in the second and third generation. Highly saprophytized strains have failed to give this reaction in

various peptones (Witte's, Difco, Parke, Davis and Co.). Lead acetate and neutral red remained unchanged; the methyl red test was positive, the V/P reaction was negative. The strains tested quite recently were more brilliant green tolerant than B. coli or B. dysenteriae. Based on the above cited characteristics the group number of our bacillus is B. 222.2332033.

The fermentation reactions, namely, production of acid, noted in Hiss serum water or peptone-phosphate solutions, are summarized in table 1. For comparison two anaerogenic colon strains, also isolated from urinary infections, are included.

TABLE I

THE CULTURAL CHARACTERISTIC OF ANAEROGENIC STRAINS ISOLATED FROM URINARY INFECTIONS

	Hemophilic Anaerogenic Paracolon	Anaerogenic Metacolon	Anaerogenic B. Coli
Motility	0	0	±
Gelatin liquefaction	0	0	0
Milk	Alkaline or acid P_H 6.6 (10 days)	Alkaline	Acid—coagulated (5 days)
Indol	±	±	+
Lead acetate	0	0 or +	0
Neutral red	0	0 or +	+
Glucose	A. P_H 5.5 (5 days)	A. P_H 5.8	A. P_H 4.8
Levulose	A.	A. P_H 5.5	A.
Galactose	A.	A.	A.
Mannose	A.	—	A.
Mannitol	A. P_H 5.8 (5 days)	0	A. P_H 4.8 (5 days)
Maltose	A.	0	A.
Rhamnose	A.	0	0
Xylose	A.	0	A.
Arabinose	A.	0	A.
Sorbitol	A.	0	A.
Dulcitol	0	0	A. and 0
Adonitol	0	0	0
Lactose	0	0	A.
Sucrose	0	0	0
Raffinose	0	0	0
Erythrite	0	0	0
Salicin	0	0	A.
Dextrin	0	0 or A. slight	0
Inulin	0	0	0
Inosite	0	0	0
Glycerin	0	—	—
Vosges-Proskauer	0	0	0
Methyl red	+	+	+
Urine	Alkaline (15)	Alkaline	Acid

In this connection we emphasize the fact that only saprophytic strains, after ten successive transplantations on plain agar were tested, the exact nature of the organism being recognized only at a period when all the original hemophilic strains had acquired saprophytic properties. The tests were repeated recently with the strains kept under artificial cultivation for over a year and results identical with those noted September, 1918, and August, 1919, were obtained. Acid, but no gas is formed by our bacillus in mediums containing the various hexoses, mannitol maltose, rhamnose, xylose, arabinose and sorbitol, but not in dulcitose, adonitol, sucrose, raffinose, salicin, dextrin, inulin, inosite and

glycerin. The acid fermentation is rather sluggish and the end reaction never goes below P_H 5.5. These characteristics would place our organism with group III of the classification of Winslow, Kligler and Rothberg; some reactions, however, indicate a relation to group IV.

Agglutination Tests.—The cultural characteristics cited above, suggested the agglutination reactions to place this organism more satisfactorily in the dysentery-paratyphoid group. It was immediately realized that such a procedure would be of limited value on account of the capsulated nature of the bacteria. The negative results obtained with a variety of specific serums testing the capsulated parasitic and saprophytic strains, are therefore of no significance. Even the serum of a rabbit highly immunized with such strains failed to agglutinate the immunizing bacillus. As already stated, the parasitic strains gradually lose their capsules and it is with such organisms that a new series of agglutination tests was set up. Again, negative results were recorded. A rabbit-immune serum with a titer of 1:400 agglutinated only several strains of our bacillus. A large series of anaerogenic paracolon and colon strains were clumped in dilution of 1:2 or 1:5. The same strains were, however, also agglutinated by normal rabbit serums in the same dilutions.

The negative agglutination test obtained with the patient's serum must be ascribed to the use of a capsulated organism and cannot serve as a criterion for the nonpathogenicity of this paracolon bacillus. With the saprophytic noncapsulated strains additional tests were only possible at a time when the urinary flora had been displaced by a typical B. coli communior. In this connection we desire to call attention to the importance of serologic studies in urinary infections. It is not uncommon to find negative agglutination reactions[1] in chronic pyelitis and cystitis, and even after a prolonged, intensive vaccination that may result in complete recovery such tests can be entirely negative. Observations of this character have more than academic interest and should therefore be investigated in detail.

Pathogenicity. — Young guinea-pigs and mice inoculated intraperitoneally with $\frac{1}{10}$ slant of a blood-agar culture of the parasitic strain may die in from 24-48 hours showing at necropsy a muco-fibrino-purulent peritonitis. Subcutaneous injections produce a slight infiltration. Rabbits on intravenous application tolerate one-half and even one slant of the same organism. The saprophytic strains are only fatal for guinea-pigs in 1-2 slant doses. Other animals were not used for pathogenicity tests. A specific localization in the urinary passages of rabbits was not noted in a small series of experiments. Old cultures contain apparently toxic substances, which produce on intravenous inoculation of rabbits transitory illness; rhinitis, rapid respiration and diarrhea are usually observed for from 10 to 12 hours.

Intravesicular injections of rabbits with parasitic and saprophytic strains failed to produce a cystitis; the introduced organism could be demonstrated for from 24-72 hours.

B. alkalignes.—The concomitant B. alkaligenes regularly found in the urine from the bladder or from the left or the right ureter corresponded in every respect with the type strain at our disposal. Culturally the colonies of this organism were characteristic and could be distinguished from the anaerogenic, hemophilic paracoli. Transformation of properties, which could suggest a close relation with these organisms, were not recorded. The strain was non-

[1] See Dudgeon: Lancet, 1908, 1, p. 615.

pathogenic for rabbits in doses of 1/5 of a slant and did not exhibit specific elective properties for the rabbit urinary system. The patient's serum agglutinated the organism on June 20, 1918, in a dilution of 1:80. This reaction may be interpreted as a slight response to the invasive and pathogenic properties of this organism. Unfortunately no opportunity was afforded to test the patient's serum after vaccination or later in the course of her illness.

As stated in the history, the bacterial flora changed completely after the operation. The anaerogenic, originally also hemophilic, paracolon has disappeared; a typical B. coli communior has always and repeatedly been isolated. Many tests have uniformly demonstrated an organisms that behaved biochemically and serologically in an identical manner and characteristic of B. coli.

DISCUSSION

We carefully consulted the extensive literature [2] on the bacteriology of urinary infections. Most of the publications are valueless, the data being collected in a period when blood plates or enrichment in blood broth were not considered necessary as a routine procedure for the study of urinary micro-organisms. Due credit should be given to D. J. Davis,[3] who in 1910 called attention to the occasional occurrence of hemophilic bacilli in urine; also to V. C. David [4] who in a series of 50 urinary cultures derived from diseases of the bladder and kidneys encountered a gram-positive, slightly anaerobic influenza-like bacillus. At first we were inclined to consider the parasitic strain of our bacillus closely related to the one described by Davis. His organism grew only on hemoglobin mediums, the colonies were very minute and opaque and were always hemolytic. The latter features were not observed with our organism; and again the size and tendency for thread formation were more colon-like than diptheroid, as carefully described by Davis for his organism. In many respects our bacillus resembled the B. pseudo-influenzae isolated by Wolff [5] from the bronchi of a rat. Our hemophilic organism, in a manner similar to Wolff's bacillus after repeated transplantations on artificial medium or in the human host subsequent to vaccination, to a clinical relapse or to other unknown factors, reverted "atavistically" to a saprophyte, comparatively easily cultivated on ordinary hemoglobin-free medium. Deprived of its hemophilic tendencies

[2] Rovsing: Die Infektions-Krankh. der Harnwege, 1899; Koll: Intern. Abstr. of Surgery, 1915, 20, p. 349; Franke: Ergebn. d. Chir. u. Orthopädie 1913, 7, p. 671; Blumenthal and Hammer: Mitt. a. d. Grenzgeb. d. Med. u. Chir., 1908, 18, p. 642; Kodama and Krasnogorski: Centralbl. f. Bakteriol. I, O., 1913, 69, p. 8; Wulff: Centralbl. f. Bakteriol. I, O., 1912, 65, p. 27.

[3] Jour. Infect. Dis. 1910, 7, p. 599.

[4] Surg., Gynec. & Obst. 1914, 18, p. 432.

[5] Centralbl. f. Bakteriol., I, O., 1903, 33, p. 407.

the bacterium could be readily studied by means of carbohydrate mediums and some suggestions as to its possible classification were obtained. Applying the recent findings of Winslow, Kligler and Rothberg,[6] Gettings and Inman [7] and others made with this class of organisms, one would be inclined to place the saprophytic strains with the B. Flexner-dysenteriae or B. gallinarum group of bacteria. The agglutination and pathogenicity tests and the viscid appearance of the colonies did not, however, justify this conclusion, irrespective of the fact that Foerster [8] and also Hilgers [9] quite recently described the findings of true agglutinable dysentery bacilli in the urine. It is not unlikely that the organisms described by the two workers belong to the same group of bacteria as our own. Decidedly more suggestive are the descriptions given by Herrold and Culver [10] for the so-called "paracolon-bacilli." The few carbohydrate reactions recorded by them correspond well with those found for our bacillus. Nongas-producing urinary colon, paracolon or even meta-colon (Jensen-Bahr's classification in Wulff's publication) are not infrequently encountered in urines. Mair,[11] Wilson,[12] Sörensen [13] and Arkwright [14] described such organisms and we therefore decided to place our bacillus tentatively with the paracolon group and designate it as an anaerogenic paracolon bacillus.

The peculiar mucoid, viscid character of the colonies of the saprophytic strains recalled the observations by one of us (K. F. M.)[15] made several years ago on a bacillus (B. nephritidis-equi or B. viscosum-equi of Magnusson [16]) isolated from renal abscesses of a horse. This organism produced such a slimy zooglea-like growth that filaments of from 10 to 20 cm. could be withdrawn on touching with a needle. B. viscosum is a colon-like organism; it grows only on glycerol agar medium, produces a toxin and dies out readily on artificial mediums. Degen [17] found a similar organism, which he described under the name of B. polymorphus-suis. Unfortunately the descriptions available are

[6] Jour. Bacteriol., 1919, 4, p. 429.
[7] Medical Research Committee, Special Report Ser. No. 30, 1919.
[8] München. med. Wchnschr., 1918, 65, p. 205.
[9] Centralbl. f. Bakteriol., I, O, 1919, 83, p. 414.
[10] Jour. Infect. Dis. 1919, 24, p. 114.
[11] Brit. Med. Jour. 1906, 1, p. 438.
[12] Jour. Hyg., 1908, 8, p. 543.
[13] Centralbl. f. Bakteriol. I, O., 1912, 62, p. 582.
[14] Jour. Hyg., 1913-1914, 13, p. 68.
[15] Report of Government Bacteriologist; Dept. of Agriculture, Pretoria, Transvaal, 1908-1909, p. 122-158.
[16] Jour. Comp. Pathol. & Therap. 1919, 32, p. 143.
[17] Thesis, Giessen, 1907.

incomplete and it would be unwise to consider our bacillus identical with one of these organisms even when some of the characteristics seem to be analogous.

The systematic position of our bacillus is of subordinate interest when we consider more carefully the observation dealing with what was termed parasitic and saprophytic strains. Originally isolated from the urine of a case of hydronephrosis, the bacillus exhibited strict hemophilic properties and distinct capsule formation. These characteristics were subsequently lost on artificial cultivation in vitro and apparently also in the human host. It may be mere coincidence that our bacillus, which originally grew on blood only, developed on plain agar when seeded with urine collected from the patient after she had been vaccinated and had suffered from a relapse. One fact is certain, that systematic urine cultures made this observation possible and materially assisted in the final identification of the organism.

Hemophilic and anaerogenic properties and capsule formation are suggestive, in the sense of Sauerbeck, of a "bacterial immunity by structural adaptation." As already suggested, certain cultural characteristics such as viscosity and loss of gas production are not uncommon with organisms obtained from urinary infections. We have been consulted repeatedly concerning such non-gas producing, slow lactose fermenting colon bacilli isolated from the urine, and we gained the impression that possibly one or several factors as yet incompletely understood or investigated exert a strongly modifying influence on the microbes of the urinary tract. Only in assuming such a condition is it possible to appreciate the fantastic list of bacteria described about 10 years ago by Tanaka.[18] In our particular case the adaptation of our bacillus was not only directed against these rather common influences, but was primarily intended for existences in living tissues. Capsule formation and preference for hemoglobin substrata made their appearance. Removed from the soil to which the organism had been functionally adjusted, and grown on artificial mediums, it gradually reverted atavistically to its ancestral type, namely, a nongas-producing paracolon. It is not unlikely that in the course of time and on suitable mediums, our organism may even acquire the ability to produce gas from some carbohydrates. Such a transformation has been described by Arkwright for a nongas-producing B. acidi-lactici isolated from the urine. And again

[18] Ztschr. f. Urol., 1909, 3, p. 5.

Revis [19] and Penfold [20] were able to suppress gas production by the use of chemical—malachite green and chloracetic acid. How far the concomitant B. alkaligenes influenced the adaptation of the parasitic strains and how far the vaccination and the frequent clinical recrudescences favored reversion to type cannot be answered definitely. In a paper on irregular typhoid bacilli recently written by one of us (K. F. M.)[21] attention was called to the importance of functional changes of micro-organisms causing infections in immunized or protected human beings. There are sufficient observations available that clearly indicate that the urinary secretion may exert a "degenerative" or inhibitive influence on the functions of many organisms of the colon group. Studies on bacteria isolated from urinary infections should therefore offer interesting material to the important problem of bacterial variability and adaptation.

SUMMARY

A bacillus isolated from the urine of a case of bilateral infected hydronephrosis is described. It grew as a parasitic capsulated strain only on a medium containing hemoglobin. The bacillus is apparently a member of the paracolon group of bacteria found in urine and is best designated as hemophilic nonaerogenic paracolon. After four months' cultivation artificially it acquired the property of growing on hemoglobin-free substrata and fermented without gas production the following carbohydrates: hexoses, mannitol, maltose, rhamnose, xylose, arabinose and sorbitol. Samples of urine cultured after the patient had been vaccinated with a heat killed, tricresolized bacterial suspension of the original parasitic strain and after a clinical recrudescence, demonstrated the same organism which grew on nonhemoglobin mediums and which in every respect corresponded with the saprophytic strains obtained by successive cultivation on artificial mediums.

[19] Centralbl. f. Bakteriol, II, 1911, 31, p. 1.
[20] Jour. Hyg., 1912, 12, p. 195.
[21] Jour. Infect. Dis., 1920, 27, p. 46.